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Original Article

Sleep quality among community-dwelling elderly people and its demographic, mental, and physical correlates

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Abstract

Background: Sleep quality is an important predictor of well being in the elderly. However, the effects of depression and physical activity on sleep quality among elderly are less clear.
Methods: One hundred older individuals who met the inclusion criteria were randomly sampled from a Taipei district elderly residential list. Door-to-door interviews were conducted. Sleep quality (the outcome variable), physical activity and depression symptoms were measured by the Pittsburgh Sleep Quality Index (PSQI), Physical Activity Scale for the Elderly (PASE), and Taiwanese Depression Questionnaire (TDQ), respectively. Logistic regression was performed to examine the relationship between the above major variables.
Results: A half of the elderly had short sleep onset (<15 minutes) but reported poor sleep quality (PSQI > 5). Twenty-two percent of community-dwelling elders used psychoactive medication for sleep. The prevalence of depressive disorders (TDQ ≥ 19) was 7%. Although both physical activity and depression were significantly associated with sleep quality in the univariate analysis, only depression remained significant after adjusting for age, gender, education, marital status, and chronic illness confounders in logistic regression (OR = 1.31, 95% confidence interval = 1.12−1.52).
Conclusion: Elderly depression symptoms was the only factor significantly associating with poor sleep quality after adjustment. Higher level of physical activity was associated with better sleep quality in univariate analysis but not in multivariate analysis, which considered the factor of elderly depression symptoms in the elderly. The role of physical activity in late life potentially influence sleep quality but may have less significance compared with depression. Therefore, we suggest the need for more future research to investigate the relationship between elderly people's sleep and physical activity.

Keywords: community-dwelling elderly; depression; physical activity; sleep quality

1. Introduction

Sleep problems in old age are prevalent and have been known to be associated with physical and psychological factors.[1−3] Depression and hypnotics use were, in particular, suggested as strong correlates with poor sleep.[4,5] Conversely, various alterations of sleep architecture (e.g., decreased deep sleep, impaired sleep continuity, and duration) can be identified in patients with depression.[6] The relationship between depression and sleep disturbance has been hypothesized to be bidirectional, with depression increasing the risk of poor sleep and poor sleep predicting depression.[3,6,7] While late-life depression in the community was prevalent, ranging from 8.8%−15.3%,[4,8] severe depressive disorder was found in less than 3% of these people.[9] Different manifestations of late-life depression that might be distinctive from major depression[4] are likely to be one of the explanations causing variations in prevalence. Alhough no known relationship has been

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confirmed, the effects of other personal and physical health-related factors should be studied further to broaden health promotion strategies for sleep and depression.[10]

Given that the elderly are vulnerable to mental illness and sleep problems, physical health conditions and body activity level further confound the above interactions. The mechanism between them has been unclear, but physical activity has been empirically regarded as a facilitator for mental health and sleep.[10] In observational studies, physical health and sleep quality were demonstrated to be significantly linked to each other.[11,12] Specifically, exercise or regular physical activity was found to be protective for people with fatigue syndrome, and they may also promote sleep and quality of life in patients with cancer.[13,14] While the majority of studies supported their relationship,[15−17] some were against the effect of exercise on sleep quality.[18] A possible explanation for the neutral effect of exercise is that researchers assessed whether participants had exercised over a certain intensity and frequency (e.g., more than three times a week, more than 30 minutes each time), which may not be sensitive enough to detect minor difference of levels of physical activity among the two groups of people with better or worse sleep. Therefore, the definition of physical activity should be identified when making comparison between studies.

Elderly physical activity is different from that of the young population and requires a short and categorized enquiry format based on different activity levels to get reliable responses.[19] The aspects of physical activity can be defined as including light/moderate/heavy intensity activities, household chores and activities,[20] occupational activities, and sports.[19,21] Older people were found to have lessened association between emotion, physical activity, and sleep compared with younger counterparts.[10] However, previous studies have not investigated the relationship between depression, physical activity, and sleep quality among community-dwelling elderly people. It was therefore the aim of the study to examine these factors and their impact on sleep quality among the elderly population. In considering both the influences of depression and physical activity, it was hypothesized that they would be significantly correlated with sleep quality, adjusting for potential confounding factors.

2. Methods

2.1. Study setting

The study was a cross-sectional survey of older residents more than 65 years of age in Da-An District in Taipei City, Taiwan, where there were approximately 310,000 residents[22] (district elderly population was about 21,700). The district is situated in the south central area of Taipei and known for its accumulated educational institutes, recreational places, and high-level of socioeconomic populations, particularly among the elderly. The researchers acquired approval from the Research Review Committee of the Graduate Institute of Department of Nursing, National Taiwan University, Taipei, and received a residential list from the District Health Service Center (DHSC). In order to get a district representative study group, simple random sampling was employed. According to Polit and Hungler,[23] sample size was estimated as 126 when the significance level (α) was set at 0.05, power was set to be 0.80, and the effect size as 0.25. Given a response rate of around 70%, the authors needed to obtain a sample of 180 individuals. Thus, simple random sampling was performed based on the district elderly list provided by the DHSC, with the elderly being numbered to achieve the study sample of 180. Door-to door interviews resulted in a total of 100 older people who agreed to participate with written informed consent (response rate, 55.6%). Those conforming to the following inclusions criteria were included in the study: (a) age of 65 years and older, (b) no observable physical impairment, (c) spoke Mandarin or Taiwanese, and (d) no recognizable cognitive impairment as measured by the Short and Portable Mental State Questionnaire (SPMSQ) in order to get reliable responses.[24] All of the participants were instructed with the study by telephone before home visits. Face-to-face interviews with a structured questionnaire were accomplished by one of the authors to ensure consistency during the year of 2001.

2.2. Measurements

The researchers collected data of demographic features (i.e., age, sex, education status, and marital status) and self-reported chronic illness of all physical systems based on a physician's diagnosis. Self-rated health status was regarded as covariate in this study, which was defined as a personal perception of one's overall health condition rated in a 5-point Likert scale (1 as very poor; 5 as very good). The scales used to measure sleep quality, physical activity, and depression symptoms were the Pittsburgh Sleep Quality Index (PSQI), the Physical Activity Scale for the Elderly (PASE), and Taiwanese Depression Questionnaire (TDQ)-Chinese versions, respectively. These measures were valid and showed good test-retest reliability in other studies[25−27] and the current one (Pearson's correlations between test-retest results were 0.79, 0.89, and 0.91).

2.2.1. PSQI

The scale assesses a person's reported sleep status in the past month. It evaluates personal attribution of poor sleep, including nine reasons for sleep disturbance (difficulty falling asleep within 30 minutes, midnight awakening, toileting, difficulty breathing, coughing, too cold/hot, pain, nightmare, snoring, and others) and abnormal sleep that caused difficulties of functional performances (difficulty staying awake for driving, eating or daytime social activities, difficulty staying energetic to do things well, prescribed or over-the-counter psychoactive medication used for sleep). The more frequently the symptoms appeared, the higher the scores and the worse the sleep quality. For example, the researcher asked a person, "How many days in a week over the past month did you suffer from poor sleep due to difficulty falling asleep within 30 minutes?" The ratings 0−3 indicate never, once a week, twice a week, and more than three times a week, respectively, and

the range of total score is between 0−21. The scale has been found to be a valid and reliable scale, with retest reliability of 0.84 in a group of Taiwanese elders living in an institution.[18] A cut-off point of 5/6 was used in this study, with higher scores indicating worse sleep quality.[28]

2.2.2. TDQ

The TDQ is a DSM-III-R derived scale that includes 18 depression symptoms that screen the tendency for elderly depression in the community. The researchers evaluated the affection, behavior, cognitive, and drive change during the past week, which were likely to be clinically significant for a diagnosis of major depression. All items were summed to get a total score of 0−54, with higher score of 0−3 in each item indicating worse mental health status (no or seldom, sometimes, often, most of the time, or always). A cut-off point at 18/19 resulted in 89% sensitivity and 92% specificity, and was suggested as a valid and reliable screening tool for late-life depression in the community.[26]

2.2.3. PASE

Considering different intensity, frequency, duration, and types of physical activities among the elderly, a structured questionnaire that is inclusive of specific activity types for the elderly is suitable for epidemiologic surveys.[19] In this study, PASE was used to measure the participants' general activity level. It was originally designed to measure the quantity and quality of physical activity in the past week among community-dwelling elderly people in large epidemiologic studies.[19] In this study, the scale was slightly modified from the Hong Kong version provided by the original inventor. The utilization of the permitted Chinese version used in Taiwan was developed by the authors due to linguistic difference between both spoken and written language used in Taiwan and Hong Kong. The assessment included the duration of physical activity per day (less than 1 hour, 1 ∼ 2 hours, 3 ∼ 4 hours, more than 4 hours) and frequency of each level of physical activity per week (never, 1 ∼ 2 days, 3 ∼ 4 days, and 5 ∼ 7 days) inclusive of different intensity of activities from low, medium, and strenuous levels to muscle endurance activities as well as house chores. Calculation of the total score was first based on an item-by-item recoding procedure. The pairwise items of weekly frequency and duration of activity were then multiplied and divided by 7 to get an average daily activity level. All sets of scores were then summed after multiplying each score by a constant to weigh different components of physical activity. Three-week retest reliability was performed on 37 participants in a subgroup of elderly people from a public elderly residential house and was found to be highly correlated ($r = 0.89$, $p < 0.001$) in the pilot stage of this study. The results showed that the PASE-Chinese version is a highly reliable and valid study tool to be used in the community setting for the elderly. Moreover, the authors used a '6-minute walk test'[29] to validate the scale and which scores (in minutes) showed significant association with PASE scores ($r = 0.38$, $p < 0.01$). Apart from construct validity, the authors revised the activity classification table according to two researchers with professional backgrounds in physical education. Considering the cultural differences and adequacy of applying the survey to Taiwanese elderly, items that did not exist or were not suitably classified in the society of Taiwan were revised according to the following principle:

1. Items removed from the original scale due to low prevalence in Taiwan: Arrow technique, rowing boats, cricket, horse riding, ice skating, darting, football, etc.
2. Items modified due to cultural difference: "yoga" and "gymnastics" were recategorized from the original category of "Enhancing muscle power and muscle endurance activity" into low- and medium-intensity activity, respectively.
3. Items added into the physical activity list: Going window-shopping was added into the category of "strolling" because it is a common physical activity among Taiwanese elderly.

Moreover, the following activities were included in the low-/medium-/heavy-intensity physical activity categories in the list: Singing/hiking or fast walking, swinging the hula hoop, and various Qigong exercises/climbing stairs.

2.3. Data analysis

The authors first tested the feature of normal distribution of the main continuous variables, including sleep quality, depression, and physical activity as measured by PSQI, TDQ, and PASE, respectively. Data were ensured as having normal distribution before being adopted into further analytical analysis.[30] The variables of sleep quality in continuous and categorical forms were utilized in univariate and multivariate analysis, respectively. Univariate analysis by independent *t*-test for binary variables and one-way analysis of variance for variables of multiple categories were performed. Depression and physical activity scores were regrouped into categorical variables based on the value of diagnostic cut-off point and mean score of the study participants, respectively, for univariate analysis. Significance level was set at $p < 0.05$. Factors that were significantly associated with elderly sleep quality in the univariate analysis were considered to be potential confounding factors. The rationale for the selection of adjusting factors in the multivariate model was based on the parsimony principle and statistical results. Further, multivariate analysis by logistic regression with the "enter" method selected was executed to examine significant factors related to late-life sleep. In the logistic regression model, sleep quality was entered as the dependent variable, while physical activity and depression were the major exposures of interest. Moreover, the odds ratio and 95% confidence interval were calculated to evaluate the impact of each considered factor selected in the model. SPSS for Windows 14.0 (Chicago, Illinois) was used to perform all of the analyses.

3. Results

The study sample was comprised of 100 community-dwelling elderly people, and 55% of them were women. The

mean age of the sample was 74.7 ± 5.3 years. About one-half the patients (49%) reported poor sleep quality (PSQI > 5). Mean PSQI score was 6.3 ± 4.4. Forty-two percent of the sample had total sleep time of over 7 hours, while 9% reported less than 5 hours. In terms of sleep onset, 47% fell asleep within 15 minutes; 28% of them fell asleep after over 30 minutes. The three major reasons for sleep disturbances of the participants who suffered sleep disturbance in a week (at least three times) were visits to the toilet (78%), loud snoring (either partner or her/himself) (19%), and nightmare (19%). Moreover, 22% of the community-dwelling elders used psychoactive medication at least once a week to help their sleep.

Women had significantly worse sleep compared with men (Table 1). Age and education did not significantly correlate with poor sleep. Better self-rated health status was associated with better sleep quality. Those participants who evaluated their own health as good or very good slept much better than those reported to have poor health status. As for the influence of chronic illness conditions, cardiovascular disease, hypertension, musculoskeletal disease, endocrine, and metabolic disease were all found to be correlated with sleep quality, with those diagnosed with endocrine-metabolic disease having the worse quality of sleep.

Overall, 40% of the participants did not have exercise habit, and 63% had lower physical activity than the average score as a whole (Table 1). The average score of PASE for the total sample was 60.1 ± 41.4, with men and women scored 64.6 ± 39.9 and 56.5 ± 42.6, respectively ($p = 0.24$). It was consistent that elderly people with exercise habit or higher level of physical activity had better sleep quality. Those with exercise habit had lower scores on PSQI (5.7 ± 3.9) than those without (7.3 ± 5.0) ($p = 0.08$).

The prevalence of potential depressive disorders (TDQ score ≥ 19) was 7% among the community-dwelling elderly (Table 1). Mean score for TDQ for the sample was 5.1 ± 7.0. Association between depression (using the standard cutoff 18/19) and sleep quality was significant. Moreover, correlation between main variables of sleep quality, depression scores, and physical activity scores indicated that they were all significantly correlated with each other (Table 2). In summary, factors that were found to be significantly associated with sleep quality in univariate analysis included female sex, self-rated health status, chronic illnesses, level of physical activity, and depression symptoms. Findings from the logistic regression (Table 3) showed that elderly depression symptoms was the only factor associating with sleep quality after adjusting for age, sex, education, marital status, and chronic illnesses (odds ratio = 1.31, 95% confidence interval = 1.12–1.52).

In a secondary analysis of the relationship between psychoactive medication use and the three main variables of this study, medication use was significantly associated with worse sleep quality (10.6 ± 4.5 vs 5.1 ± 3.6, $p < 0.001$) and more depression symptoms (7.2 ± 2.8 vs 3.7 ± 5.9, $p < 0.001$) but not with the level of physical activity.

Furthermore, in considering potential risk of multicollinearity in the regression model, the authors selected variables based on findings of univariate analysis and checked the correlation matrix between them (Table 2). A test of collinearity was also performed and showed that it was less of a concern (variance inflation factors value = 1.8; tolerance = 0.8).[31] The above test indicated that the results of this study were relatively genuine.

Table 1
Univariate analysis of sleep quality score with related factors ($n = 100$).

Variables		*n*	Mean	SD	*p* value
Sex	Women	55	7.44	4.71	0.004
	Men	45	4.98	3.61	
Age groups	65 ~ 69	30	6.93	4.60	0.508
	70 ~ 74	24	6.33	4.65	
	75 ~ 79	30	6.50	4.58	
	≥80	16	4.88	3.20	
Education	Illiterate	12	9.67	5.85	0.085
	Elementary	26	6.42	3.96	
	Junior high	10	6.00	2.26	
	Vocational/senior high	27	5.63	4.11	
	College and above	20	5.55	4.65	
Marital status	Married/cohabiting	82	6.00	4.20	0.146
	Divorced/separated	2	4.50	2.12	
	Widowed	16	8.25	5.23	
Self-rated health status	Very poor (1)	5	11.60	7.47	< 0.001[a]
	Poor (2)	11	10.55	4.27	
	Fair (3)	45	6.09	3.59	
	Good (4)	26	4.96	3.92	
	Very good (5)	10	3.50	2.46	
Cardiovascular disease	Yes	49	7.78	4.57	0.005
	No	51	4.94	3.78	
Hypertension	Yes	43	8.16	4.66	0.005
	No	57	4.95	3.67	
Musculoskeletal disease	Yes	33	7.67	4.59	0.040
	No	67	5.67	4.19	
Endocrine and metabolic disease	Yes	25	8.44	4.93	0.129
	No	75	5.63	4.01	
Physical activity	Higher than average	37	4.78	3.74	0.004
	Lower than average	63	7.24	4.54	
Depression	<19	92	6.14	4.32	0.292
	≥19	7	8.50	5.04	

[a] Scheffe test results indicated that between-group differences of sleep quality in self-rated health were poor > good, poor > very good.

Table 2
Correlation[a] matrix of age, self-rated health and main continuous variables of interest.

	Age	Sleep quality	Self-rated health	Physical activity	Depression symptoms
Age	1.000				
Sleep quality	−0.127	1.000			
Self-rated health status	0.028	-0.414 ***	1.000		
Physical activity	−0.249 *	−0.271 **	0.192	1.000	
Depression	0.081	0.517 ***	−0.419 ***	−0.234 *	1.000

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
[a] Pearson's correlation was performed in these statistics.

Table 3
Logistic regression[a] of the factors predicting sleep quality of community-dwelling elderly people.

Variables	Odds ratio	95% confidence interval	*p* value
Age[b]	0.95	0.85, 1.05	0.289
Sex	1.65	0.60, 4.51	0.328
Self-rated health status[b]	1.03	0.96, 1.10	0.399
Physical activity[b]	0.92	0.78, 1.10	0.359
Depression[b]	1.31	1.12, 1.52	0.001

[a] The model was adjusted for age, sex, education, marital status, and chronic illness status.
[b] Continuous form of these variables was put in the model for analysis.

4. Discussion

4.1. Major findings

The study recruited a sample of elderly residents of Da-An District in Taipei. One hundred community-dwelling elders were interviewed via home visits, and 49% of them reported poor sleep quality (PSQI score > 5). It was found that 22% of the study participants used psychoactive medication to help them sleep; 7% reported having significant depression symptoms (TDQ $\geq$ 19). Higher level of physical activity was associated with better sleep quality when independently considering physical influence on sleep; however, the above correlation was confounded by depression, which was significantly associated with poor sleep quality after adjusting for age, sex, education, marital status, and chronic illnesses. In summary, depression may have more influence on elderly sleep when a person suffered from both mental and physical problems.

4.2. Geriatric depression and its influence on sleep quality

This study highlights the need for early identification and intervention of depression symptoms in geriatric population with sleep problems. The 1-week prevalence of depression was 7% among the community-dwelling elderly people in this study, which was comparable with some studies in Taiwan (8.8%–9.8%)[4,32] but lower than others (1-month prevalence of neurotic depression: 15.3%).[8] Reasons for lower prevalence may be related to different diagnostic criteria for the definition of geriatric depression (e.g., neurotic depression or major depression) and various screening tools selected in community surveys. Therefore, one should be cautious when making comparison between studies. Furthermore, depression was identified as one of the main factors contributing to sleep problems.[3,11,32–34] In this study, depression was the only factor when considering related factors to be associated with sleep quality, making mental health assessment an important strategy in alleviating sleep problems. Notably, the 22% of patients reporting psychoactive medication use for sleep in the past month was consistent with other studies.[3,5] Previous study pointed out that such medication use by the elderly might strongly attenuate the relationship between depression and sleep quality.

Another issue concerned the fidelity of correlation between depression and sleep quality when using the two screening scales (TDQ and PSQI, respectively) with overlapping symptom measurement, i.e., sleep problems. It should be noted that the TDQ is an overall assessment of depressive related symptoms in community-dwelling elders, with sleep problem being one of the 18 items. The general score over a cut-off point stands for elevated possibility of clinically significant depressive disorders. Hence, there is not a single item that can determine the severity of sleep problems. Moreover, to validate this correlation, we removed the sleep-related item in the TDQ and found the significance remained ($r = 0.45$, $p < 0.001$). Hence, the finding regarding the relationship between the two variables should be relatively true and reliable.

4.3. Elderly physical activity and its correlation with sleep quality

The results confirmed the effect of elderly physical activity on sleep, but we should first consider the influence of depression when elderly people have both physical and mental problems. It was suggested that depression may have more influence compared with physical and other demographic factors. Although plenty of studies supporting the positive effect of physical activity on sleep,[12,15–17] the role of depression cannot be neglected and should be dealt with prioritization before considering any exercise protocol or physical health promotion in the elderly.

4.4. Study limitations and implications

The current study has provided evidence on the significance of late-life depression for sleep among the community-dwelling elderly. It is among the few studies that concurrently considered quantitative physical activity level, sleep quality, and depression in a community-dwelling elderly sample. However, there were several limitations. First, generalizability of this study is limited because the sample size was too small for drawing firmer conclusions. Also, we failed to get demographic details of nonparticipants from the District Health Service Center to make comparison with participants. But the use of face-to-face interview method during field data collection obviously increased the reliability of the findings. Secondly, the evaluation of sleep quality and major variables were self-reported and might have resulted in memory or information bias, even though the researcher had used systematic techniques to draw responses. For example, poor sleep in the TDQ was found in 23% of study patients, while 49% of them reported good sleep quality measured by PSQI $\leq$ 5. However, there was only one question in TDQ evaluating overall sleep quality, while the PSQI has a set of sleep measurement components that could be more specific. They served different purposes and should be interpreted based on the total score. Thirdly, sleep measurement was based on subjective descriptions rather than objective assessment. There might be memory gap between certain variables such as total

sleep time and sleep onset, subsequently influencing the classification of people with good or bad sleep quality based on total score of PSQI and the results of this study. Future studies are recommended to prospectively follow up a cohort of community-dwelling elders to evaluate elderly depression symptoms and their effect on the relationship between physical activity and sleep quality over time.

In conclusion, this study provides evidence that depression among the elderly has a significant influence on sleep quality in the community setting. Frontline community healthcare professionals should raise community awareness regarding chief complaints and symptoms related to depression and sleep problems.

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